appears to have been flesh-colour for $\frac{7}{8}$ths of its base, and dark at the tip.

Total length $4\frac{1}{8}$ inches; bill 1; wing $2\frac{1}{4}$; tail $1\frac{5}{8}$.

Female. Similar, but paler in colour.

Habitat. Oaxaca, in Western Mexico.

Remark. Although I have but little doubt that I have assigned this bird to its natural place, it is with some degree of hesitation that I have included it in the genus *Cyanomyia*: its sordid, smoky-grey style of colouring renders it very distinct from every other.

XI.—*On* Dracunculus *and Microscopic* Filaridæ *in the Island of Bombay*. By H. J. Carter, Esq., Bombay.

[Concluded from p. 44.]

Observations.—Those who have given their attention to the subject cannot fail to see that these worms belong to Ehrenberg's *Anguillula*, out of which Dujardin has formed his genus *Rhabditis*, which is closely allied to our microscopic Filaridæ, as the following characters of this genus will show:—

"Body filiform, narrowed at the ends; mouth terminal, round, naked; anus subterminal; tail of the male either naked or furnished with a membrane (winged); a double spiculum; tail of the female conical, acute. The mouth is succeeded by an oblong cavity (pharynx), which is furnished with two or three longitudinal bacilla, and is distinct from the œsophagus, which is muscular and fusiform or cylindrical; stomach top-shaped or spherical, furnished with a kind of dental armature. The tail of the female is frequently prolonged into a fine point. The uterus is bifid, and the vulva situated near the posterior third of the body*."

Descriptive, however, as this is of the worms to which we have been giving our attention, yet it will not suit them in all respects. Some have papillæ about the mouth, others have tentacula or cirrhi attached to the head, and others have neither. The mouth in some is simple and suctorial, while in others it is armed with an exsertile proboscis, which appears to be but a continuation of the œsophagus; others, again, have eyes; and probably many other differences will present themselves on a more extended examination of their species, which promise to be as numerous as all those of the Nematoid Entozoa put together, if we assume that the latter are derived from the former. Hence it is desirable not to begin to group until many more of

* Micrograph. Dict., Griffith and Henfrey, p. 34.

them have become known; and therefore the generic name of "*Urolabes**," which I have employed, should only be viewed as provisional. It has been chosen from the striking habit which all these worms have of attaching themselves to some object by the tail, whether it be by embracing it or by adhering to its surface. Hence the tail would appear to be both prehensile and adhesive, if not suctorial. Having once fixed themselves in this way, they keep up an undulating movement from the tail forwards, which, in the absence of any evident purpose, seems more for respiration than anything else. They can also, when once attached to any soft substance, hold on until they wriggle themselves into its interior, either for concealment or in search of food; and this peculiarity is not more striking in the microscopic Filaridæ than it is in the young *Filaria Medinensis*.

Their especial habitat is more in the midst of the gelatinous Algæ, *Oscillatoria, Glœocapsa*, &c., than in any other place, where they not only meet with gelatine, starch, and oil for food, but frequently with a nitrogenous product in the shape of protoplasm, which is liberated from the decomposition of the vegetable cells with which such Algæ are generally associated; and they abound in such matter not only in the fresh- and salt-water accumulations about the island of Bombay, but everywhere during the "rains;" so that probably there are many which only come into life and breed, like some of the Naïdina, during this part of the year.

The males and females may be generally found together where the species is plentiful; but this is frequently not the case, which, together with their microscopic size and constant motion under examination, or while they retain the least life, renders them very difficult to study, and requires an amount of time which very few have at their disposal to bestow upon them. Hence I have thought it better not to withhold the descriptions of those which follow *Urolabes palustris* because they are not equally detailed, but to offer them for publication so far as they go, that they may be completed by others, and thus the time that has already been spent upon them not altogether lost.

A knowledge of the external parts and the whole of the alimentary canal is easily obtained; and the anus and vulva have been assumed to be ventral in all, from analogy, as there is no other means, from their roundness and minuteness, of determining this in any other way: but many individuals are required before the form of the generative organs can be figured correctly, as these have to be pressed out before they can be seen; and, under such rough treatment, it is only one here and there

* From *οὐρὰ, cauda*, and *λάβω, prehendo*.

that affords a part of these organs distinctly, and none of them the whole at once.

In some instances, where the vulva is placed very far back, the generative organs can hardly be assumed to be symmetrical, as there is no room for an equal development of the posterior half.

In some, again, the ova undergo segmentation to such an extent before being laid, that the young worm is perfectly formed; but I have met with no instances in which it has left the egg while in the interior, so as to make the species viviparous; while in other species segmentation does not commence until the ovum has been discharged, as in *Urolabes palustris*.

Where I have had an opportunity of tracing the development of the embryo, as in *Urolabes erythrops*, the yelk has undergone the common duplicative subdivision already well known to take place in the ovum of *Ascaris*,—the divisions being widely separated at first, and then gradually becoming more approximated as the segmentation increases, until the whole is again brought together, as in the first instance, and the formation of the new being is commenced.

The breeding-season of *Urolabes palustris* appears to commence in January or February, and is all over by the beginning of May; at least, in this month, and during the "rains," I have never met with any females with eggs in them. That of the salt-water species also appears to be chiefly in the spring; while that of the species which only appear during the "rains" is of course confined to this period.

Among the generic characters given by Dujardin to *Rhabditis*, the narrow rigid tube, which appears to me to be the œsophagus, is not mentioned, and the muscular sheath which I have described is viewed alone as the œsophagus. Now, as before stated, the former appears to me to be the œsophagus, for this reason, that in *Urolabes palustris*, which is typical of all the rest in this respect, I have seen oil-globules (the food) come out of the pointed extremity of the œsophagus after its exsertion under pressure, while no food ever appears outside this or in the muscular sheath, and the narrow tube which is continued backwards from the sharp point is the only part which is in continuation with the intestine (Pl. II. fig. 11 *h*, &c.). Again, if the "top-shaped stomach" of Dujardin be that globular portion which appears just about the union of the intestine with the œsophagus in *Ascaris vermicularis*, called also by Blanchard "ventricle or stomach*," such a portion does not exist in *all* the Filaridæ that I have figured; and where it does, the constriction which forms this globular dilatation is in the sheath of the intestine

* Ann. des Sc. nat. t. xi. pl. 7. fig. 3 *d* (1849).

(which latter may be seen passing through it), and has nothing to do with the calibre of the alimentary canal (figs. 29, 30). It is at this point that the œsophagus joins the intestine, after which the latter continues of the same diameter throughout the body, or until it meets the rectum. Not having Dujardin's 'Histoire d'Helminthes,' nor indeed any of the standard works on the subject, I state this with much diffidence, and can only vouch for the truth of what I have seen myself in this respect, and which will be found delineated in the illustrations. It is not improbable that the first part of the intestine may be a little larger than the rest; but, if so, the difference is so slight that it could only be appreciated if the whole canal were seen at once, which it cannot be, as the magnifying power which is required to bring the intestine into view will only admit a small portion of the worm into the field at the same time.

Formerly I stated that in the microscopic Filaridæ the hepatic oil-globules were secreted, in part at least, by the peritoneal lining of the muscular coat; but latterly I have found that there is a distinct peritoneal membrane over those which surround the intestine, thus cutting them off entirely from the peritoneal cavity. It is to this membrane that I have applied the term of "intestinal sheath;" and so firmly are the globules held between it and the intestine, that, even after the whole is forced out of the body by pressure, the oil-globules do not escape until the intestine and its sheath are torn across, when they gradually flow forth from between the two individually, and not enclosed in cells, as those round the intestine of the Naïdina, which are so easily pressed off into the peritoneal cavity, that there does not appear to be any membrane at all between them and this cavity in these worms. When, however, we go to the posterior portion of the intestine in *Urolabes palustris* (fig. 11 *m*), which is uncovered by the hepatic layer (or, at least, where the oil-globules are very scantily present), there they are no doubt grouped in cells, as they are seen in the Naïdina, and, what is more, leave the intestine under pressure, and move off into the peritoneal cavity. What becomes of the lines of oil-globules on the peritoneal surface of the muscular coat, I have not been able to determine,—that is, whether they have any connexion with the hepatic layer, or are merely fatty accumulations.

Dujardin also applies the term "bifid uterus" to the female organs of generation; but as there is no placenta, I prefer the term oviduct or fallopian tube for the lower parts, and so on upwards, as described under *Urolabes palustris*. No doubt the uterus and the fallopian tube here are in one, and the ovary and ovisac also; but while it is desirable to apply the term "ovary" to the whole in the higher animals, it is equally desirable not

to make any division of the oviduct in the lower ones, but to call it after that part to which it comes nearest in the higher animals, viz. the "fallopian tube."

These worms, again, are too small to present any traces of a vascular or nervous system,—at least I have not been able to detect either in *Urolabes palustris*; nor have I been able to ascertain how their respiratory functions are performed, beyond the rhythmical influx and expulsion of water observed to take place in the posterior uncovered part of the intestine (fig. 11 *m*), through the anal orifice and rectum, as before stated. That this takes place in the Naïdina, and is produced there by the cilia which cover the posterior part of the intestine, I have, since my paper on the "Spermatology of *Nais fusca*" was published*, been able to determine. In trying to account for the direction in which the cilia lining the tube of the "segmental organ" carried its contents, I observed that as these (viz. the fæcal contents in the posterior part of the intestine in the same *Nais*) passed towards the anus, and thus against the direction of the cilia, so the direction of the cilia being outwards, or in the opposite direction, in the "segmental organ" should indicate an inward current through this organ,—that is, that the force of the cilia was opposite to their apparent movement†. But since then, I have, by placing some indigo in the water with another species of *Nais*, observed that it was taken into the rectum and some way up it, where it kept oscillating between the peristaltic motion of the intestine and the cilia, until some fæcal matter arrived, when, by a forcible movement of the former, the whole was expelled, and the indigo began to pass in again as before. Thus the current of these cilia was satisfactorily proved to be in the direction in which the cilia appeared to move; and the direction of the movement of the cilia of the segmental organ being outwards, would indicate an outward current in this organ. I mention this more particularly to clear up the difficulty I then had in speculating upon the probable function of the segmental organ. Now in *Urolabes palustris* there is nothing approaching to a contracting vesicle or "segmental organ" in any part of the body, and no evidence of water-respiration beyond that which I have stated. That an aërating function of this kind is performed by the posterior part of the alimentary canal of the Naïdina, is proved not only by what I have stated to occur in the *Nais* on which the experiment of the indigo was made, and by the existence of cilia on the posterior part of the intestine of *Nais fusca*, but by the fact that in another species, like, if not the same with *Nais digitata*, Gmel.‡, which is common in Bom-

* Annals, vol. xix. p. 20. † *Id.* vol. xix. p. 28.

‡ Encyclop. Méth. t. i. pl. 53. figs. 12–18.

bay, the mucous membrane of the rectum is prolapsed as it were into an expanded floral or digitated form, which is covered with cilia in constant and active motion.

Comparison of Filaria Medinensis *with* Urolabes palustris.

On comparing *Filaria Medinensis* with *Urolabes palustris*, it must now be evident that they both belong to the same family, if not to the same genus.

Thus, externally the form is the same,—that is, both are equal in size for a long extent, and then diminish towards the extremities*. The mouth and anus are the same as regards position. There are two evident papillæ on the head in each; but with the mouth they do not bear the same proportion to the body in both, for reasons which will be more evident by-and-by. There is no vaginal orifice or vulva in *Filaria Medinensis*, while there is one in *Urolabes*. Lastly, the tail is curled up and abortive, compared with the development of the body in the adult of *F. Medinensis*,—though the opposite is the case with its young one, where it is more like that of *Urolabes palustris*, and especially that of the young of this species.

In both, the integument is transparent, tough, apparently structureless, and lined by a muscular layer, which presents a number of oil-globules on its surface and a patch of sarcoid glanduliform prolongations in the vicinity of each extremity. In *U. palustris*, however, it is not corrugated or striated transversely, nor is it evidently so in the adult *F. Medinensis*.

The alimentary canal is the same—that is, it consists in each of a narrow œsophagus followed by a much wider intestine, which pursues a straight course through the body, except where it is displaced by the generative organs, to end in a short narrow rectum; but it differs in the rectum being without evident anal orifice, if there be any at all in *Filaria Medinensis*. Again, in both, the œsophagus and intestine are surrounded by their proper peritoneal sheaths, defined by a constriction opposite their point of union, while the former is also surrounded by a muscular sheath, and the intestine by the hepatic organ up to within a short distance of the rectum; the latter is seen more distinctly in the young *F. Medinensis* (figs. 6 *f* and 7 *f* & *c*).

Lastly, the organs of generation are cylindrical and double in each—that is to say, the ovisac with its terminal ovarian tubes, in *Filaria Medinensis*, by being symmetrical, would form

* This diminution is much more abrupt in the illustrations than it is naturally; this is merely in consequence of using a ruler instead of the hand alone for the outline, that this might have no irregularities. The diminution always commences a little behind the union of the œsophagus and intestine, and a little in advance of the anus for each end respectively.

two parallel halves if cut in two in the centre; but at the same time, the ovisac being continuous, uniform in size, and without constriction or projection throughout (fig. 2), besides extending with the ovarian tubes from one end of the body to the other, the whole differs very considerably from the organs of generation of *Urolabes palustris*, which only occupy the middle half, are inflected upon themselves, present a line of demarcation between the ovary and ovisac and the fallopian tube, and a constriction in the latter where it unites with its fellow to form the vagina (fig. 8).

Such are the identities and differences between *Filaria Medinensis* and *Urolabes palustris*. We have now to consider how far the latter are real, or the result of the circumstances under which *Filaria Medinensis* is developed,—that is, compelled to receive support from the surrounding tissues of that part of the human body in which it may be situated, and to retain the whole of its progeny until they are all equally and sufficiently developed for delivery.

Undoubtedly the shrunken state of the alimentary canal throughout, together with the insignificant development of the parts about the mouth, to which I have already alluded, and the apparent obliteration of the anus in the adult *Filaria Medinensis*, compared with the enormous development of the tegumentary and muscular systems, and that of the organs of generation, indicate that the former has not only not kept pace with the latter, but that it has hardly been called into action at all for the development of the organs of generation, &c.; and this is further confirmed by the fact that the head of the adult *Filaria*, always projecting first and perishing, obliterates the mouth, and thus leaves the rest of the body to be nourished and kept alive (which it is, with all the remaining part of the progeny, up to the last inch) through its surface, which nourishment must come from the tissues of the body, and still further by the presence of delicate filaments of cellular tissue adherent to the body of those worms which are extracted by surgical operation before they have begun to protrude of themselves. For the same reason, viz. the want of use, probably arises the diminutive and inflected state of the tail, fixed also to the body by an adventitious membrane; while the instinctive power which presides over the development of the body generally, knowing that a vaginal orifice for impregnation and the exit of the ova would not be required, seems to have arrested the form of the organs of generation at that point where they consisted merely of a cylindrical sac with ovaries, though it allowed the increase in size of these to go on up to that degree which would be sufficient to accommodate the whole of the progeny.

Hence the differences between *Filaria Medinensis* and *Urolabes palustris* do not appear to be real, but modifications of the former to meet the circumstances under which its development takes place; and this appears still more evident when we compare the young *F. Medinensis* with *Urolabes*; for here the former, although without the organs of generation, still has the elongated straight tail and a fully-developed alimentary canal,—so that *it* at once is so far a *Urolabes*. There are no papillæ observable on the head at this period, neither is there a spear-pointed extremity to the œsophagus; but it must be remembered that the characteristic features of the head and tail are only developed with maturity in the microscopic Filaridæ, and when young, they are all more or less alike. The young *F. Medinensis* has, however, perhaps a larger tail proportionally than the young of *Urolabes*, and is corrugated transversely, while it is as large as many specimens of the latter which have arrived at maturity: hence comes the question, whether the young *F. Medinensis* be not a monster form? and then, whether it be capable of existing after it has left the parent?—points which lead to the consideration of the mode in which *Filaria Medinensis* is propagated.

Propagation.—The propagation of *Filaria Medinensis* involves many questions: viz., is this effected by the young ones, or has the worm an external origin? and if the latter, under what form is it introduced into the human body, and whether through the skin or through the alimentary canal? Lastly, is impregnation necessary? and, if so, where does this take place?

To arrive at some conclusion respecting the propagation of *Filaria Medinensis* by its young ones, it was evident that the first object should be to ascertain if the young were capable of maintaining an independent existence; and for this purpose I took some from a healthy full-grown individual, two or three hours after extraction, when they were strong, active, and apparently without impairment of vitality; and having placed a few (for it does not do to take many, on account of the numbers which die soon rendering the water putrid), with some water, in three small saucers, each of which contained a little fine clay at the bottom (which, for fixation, had been allowed to dry there previously), I set them aside for observation under a glass case, close to the window of my room. Furthermore, in one of the saucers were placed a few bits of *Nostoc*, which had been soaked in water to gelatinize them; to a second, a little bunch of *Conferva glomerata*, about as large as an almond, was added; and the third saucer contained nothing but the clay. In this way the water remained fresh in each saucer, while the *Nostoc* afforded a kind of nidus and nutriment, and the *Conferva* and the clay

places of concealment. But after watching these young Guinea-worms for several days, none, according to the best of my remembrance (for I have mislaid the record of the experiments), lived beyond the tenth day; at all events, they all died off so quickly, that it led me to the inference that, if they survived so short a time under such apparently favourable circumstances, they could not be expected to live much longer, if even so long, when they might happen to get into a pool of fresh water, with equally unimpaired vitality,—an occurrence, again, which could only take place during the bathing of a person possessing an extruded *Dracunculus*, since the delicate, soft state of a young Guinea-worm on leaving the parent is such that its death would be inevitable in a few moments, if not liberated under water.

On another occasion, a little solution of glue was added to some young Guinea-worms which, with equal care, had been transferred from the parent to a small saucer in which there was a little portion of gelatinized *Nostoc*, but no clay; and here they were all dead by the fifth day.

To this I may add the results of Dr. Forbes's experiments, who gave the young of a Guinea-worm, fresh from a sepoy's leg, to two pups, and on examining one four, and the other twenty-four hours afterwards, found them (the young Guinea-worms) "dead in the mucus of the stomach and duodenum;" not one of them showed the least signs of vitality*. Those he placed in pure well- or tank-water "died generally the fourth, fifth, or sixth day after birth;" while others placed in "impalpable clay, partially covered with water, and exposed to the sun," lived, in one experiment, to the twentieth day, but did not gain "one particle of increase in their size." So that the want of power thus manifested to maintain an independent existence tends to the conclusion that the young Guinea-worm is not a propagative agent of the species.

The next point for consideration is whether *Filaria Medinensis* originates in the human body; and this is at once answered in the negative, if we are right in assuming that its young ones are unpropagative, since the fact of its existence being confined to tropical regions, and Europeans not getting it unless they have been in these regions, proves, if it be not propagated by its young ones, that the embryos from which it is derived must come from some other source, and that, too, extraneous to the human body.

We have now to consider by what course and under what form it is introduced into the body. As regards the former, the fact that multitudes occur in the legs and feet, while its frequency of occurrence in other parts diminishes rapidly with the

* Trans. Med. and Phys. Soc. Bombay, vol. i. p. 221 (1838).

distance of the parts from the legs and feet, in so much that it is comparatively seldom seen above the hips, strongly tends to the conclusion that it gets into the human body through the skin of the lower extremities, and that it is not introduced through the alimentary canal.

Then, as regards the form under which it is introduced, that cannot be in the shape of an ovum if it be not taken in by the mouth, because the ovum has no means of attaching itself to the surface of the body, and the embryo no means of becoming hatched or existing there for more than a few moments if hatched without water, even supposing that by chance it had lodged on and become adherent to any part of the skin. Thus we must infer that it enters the body in the form of an embryo worm.

Assuming, then, that this embryo, of whatever species of *Filaria* it may be, had that prehensile power of the tail which is not only manifested by the whole group of *Urolabes*, but by the young Guinea-worm itself, while the young of these microscopic Filaridæ, when hatched, are not wider in their transverse diameter than a human blood-globule, and the mouths of the sudorific ducts which stud the surface of the body in myriads not only exceed this in size, but contain within them elements of nutrition, it does not seem far-fetched to assume that, under the form of a *Urolabes*, at the period mentioned (that is, shortly after having been hatched), the embryo of *Filaria Medinensis* might find at least a recess in the human body into which it might wriggle itself by means of its tail, and within which it might be kept moist, obtain nourishment, and be perfectly secure from falling out, until prepared to go further. Then, assuming also that its œsophagus was furnished with a sharp exsertile point like that of *Urolabes palustris* (fig. 11 *d*), it might, from the sudorific duct, bore its way into the subcutaneous cellular tissue, where the development of *Filaria Medinensis* for the most part takes place,—or deeper still, and then by its elongation follow a most intricate and tortuous course, before its head arrived at the surface for extrication.

That the embryos of some of the Filaridæ have the power of penetrating into the bodies of animals, has been proved by Siebold* and Lespés†—by the former in the larvæ of Lepidoptera, and by the latter in *Termites*; and I myself saw the one which I have called *Urolabes parasitica* in variable plurality in the peritoneal cavity of a *Nais*, viz. *N. albida*, which I found inhabiting the very *Glœocapsa* which I had collected for the sake of the microscopic Filaridæ of all kinds which always abound in it.

* Ann. des Sc. nat. t. iv. p. 55, &c., 1855.
† Ann. of Nat. Hist. vol. xix. p. 388, 1857.

Thus the comparison of *Filaria Medinensis* with *Urolabes palustris* leads to the inference, at least, that the former is a *Urolabes* modified; that its young are not capable of maintaining an independent existence long enough to become propagative agents; that the embryo of *Filaria Medinensis* must be introduced into the human body from without; that inference is in favour of this taking place through the skin, and not by way of the alimentary canal; that this must take place when the worm is in an embryo state, or after it has been liberated from the egg; that, by the aid of the prehensile tail, and through the narrowness of the body when very young, it might thus get into a sudorific duct; that, while there, it might be kept alive by the moisture and the nutritive elements which the sudorific duct contains; and that, if provided with a sharp-pointed exsertile œsophagus, like that of *Urolabes palustris*, it might from thence bore its way into the subcutaneous cellular tissue; while the fact that the microscopic Filaridæ do penetrate the bodies of animals still further corroborates all these inferences.

It is not my intention here to do more than allude to the facts I brought forward formerly to support this argument, by the coincidence of *Urolabes palustris* occurring in great numbers in a muddy pool of water in which the boys of a small school bathed, accompanied by an extreme prevalence of *Dracunculus* among them, and the almost total absence of *Dracunculus* in another but very large school (in Bombay), in which the bathing water is taken from a deep tank excavated in the trap-rock, whose silty deposit presented no microscopic Filaridæ of any kind*,—because of itself it is inconclusive; but I may mention with advantage, perhaps, prophylactically, that mud, Algæ, and freshwater plants harbour the microscopic Filaridæ; and that those tanks which, like the wells, are kept free from all these accumulations do not contain any of them, for the simple reason that such tanks afford them neither nidus nor nutriment.

Impregnation.—If we infer that the embryo of *Filaria Medinensis* is the young of one of the microscopic Filaridæ, and that it can only enter the body shortly after it is hatched, that is, at the time when it does not much exceed the diameter of the human blood-globule, its organs of generation are then not developed, and it must therefore enter the body unimpregnated. Again, it cannot be supposed to become impregnated after getting into the tissues; for, to infer this, we must assume an amount of instinct and facility of communication, to enable the male and female to come together under such circumstances, as would be absurd; while we must also assume that all the

* Trans. Med. and Phys. Soc. Bombay, No. 2, new series, p. 45, 1853–54.

males perish, for a male Guinea-worm here is unheard of; and from whence the one figured by Prof. Owen came is not mentioned.

Mr. Lubbock's observations*, however, show that the female organs of generation may throw off buds at one time and ova at another; so that *Filaria Medinensis* may not require to be impregnated to bring forth its progeny.

However this may be, *Filaria Medinensis* is viviparous, and all her progeny are of the same size when she puts forth her head from the surface of the body; while *Mermis albicans*, which is closely allied to *Filaria Medinensis*, enters the larvæ of the Lepidoptera as an embryo, and leaves them at full growth, but *before* it has acquired the organs of generation†. The *Filariæ* which I saw in *Nais albida* were all females; and their oviducts were filled with ova in successive stages of development, each of which was provided with its germinal vesicle and nucleus, and none without it; so that while these *Filariæ* thus differed from *Mermis albicans*, they too might nevertheless have been about to leave their host, in some way or other, for impregnation.

If *Filaria Medinensis* be propagated by its young ones, and these enter the human body directly after they leave the parent, they must enter it unimpregnated, for there is no trace of the generative organs to be seen at the time of their birth; while, if they enter it afterwards, they must be born in water (for they would die out of it), and remain there until the organs of generation are developed,—to which, again, their want of power in sustaining life is opposed.

On the other hand, if it be one of the *Urolabes* which becomes *Filaria Medinensis*, and it enters the body after the organs of generation have become developed, this is quite contrary to what takes place with *Mermis albicans* and other free Filaridæ, which enter the bodies of the animals or insects which they infest in their embryo state, and leave them before the organs of generation are developed. But supposing that one of the *Urolabes* which I have described entered in a mature state, the smallest would have to bore directly through the skin; for it is twice the diameter of the mouth of one of the sudorific ducts, estimating the latter at the 1200th part of an inch in diameter,—and if *Urolabes palustris*, this is three times the diameter at least. It is true that there may be still other species of *Urolabes* which are much smaller, and in their mature state do not exceed the diameter of the orifices of the sudorific ducts; but even then it must be remembered that they have to take in with them a sufficient number of spermatozoa to impregnate the whole of

* "On the Hybernating Eggs of *Daphnia*," Phil. Trans. 1857.

† Ann. des Sc. nat. t. iv. p. 58, 1855.

their ova; and when we consider the size of the spermatophorous cells of *Urolabes palustris*, the number of ova which the female must throw off during a season, the number of spermatozoa required for their impregnation, and the small space afforded by the oviducts for the temporary reception of the spermatozoa, we must infer that, in their free state, there must be several sexual connexions during the breeding-season: for the oviducts of a *Urolabes* like *U. palustris* would not contain a sufficient number of spermatozoa to impregnate a progeny equal to that of *Filaria Medinensis*, which, as before stated, amounts to upwards of a million; while, if there were a *Urolabes* possessing oviducts of sufficient capacity for this, such a one could not, when fully impregnated, pass in through the mouth of a sudoriferic duct, and therefore must bore its way directly through the skin.

Lastly, we have to assume that, if the female does go in impregnated, a complete change of her organs of generation must take place, and the vaginal orifice become obliterated; while, if the progeny of *Filaria Medinensis* are derived from buds, nothing of the kind need occur, and the worm might pass into the body as *Mermis albicans*, &c., viz. in the embryo state. But such assumptions unfortunately only lead us to the fact that we have not sufficient data to come to a positive conclusion either one way or the other, and that we probably shall remain ignorant of the process of generation until we become acquainted with the origin of *Dracunculus*, which therefore still remains a *desideratum*.

As regards the time which *Filaria Medinensis* takes to pass from its embryo into its full-grown state, nothing is determined. Cases of *Dracunculus*, or the appearance of the worm under protrusion, take place throughout the year; but their maximum is towards the end of the dry weather and the beginning of the "rains," viz. in the months of May and July, and their minimum in January. The "register" of the Native General Hospital in Bombay gives, for the seven years ending 1858, the maximum (viz. sixty-three cases) in August, and the minimum (viz. twelve cases) in February; but there were forty-four cases in May. This, however, is not so useful here as the following result from the town of Sattara, which is about 100 miles from Bombay, because the latter is obtained from soldiers, who of course go into hospital the moment they are sick, while those who go into the Native General Hospital of Bombay, depending for subsistence on their daily work, do not go into it except when driven to it by the severity of the case. Thus, Dr. Murray shows that, from regiments in the cantonment and town of Sattara, for the six years ending 1847, Guinea-worm chiefly

prevailed in "the months of March, April, May, and June, the cases which occurred in these four months constituting three-fourths of the entire number throughout the year." The maximum was in May, viz. 125, and in June, 102 cases; and the minimum in January, viz. 11 cases, after which there is a rapid increase to May; so that it is towards the end of the dry weather and beginning of the "rains"—that is, towards the end of spring and the beginning of summer—that *Dracunculus* is most prevalent.

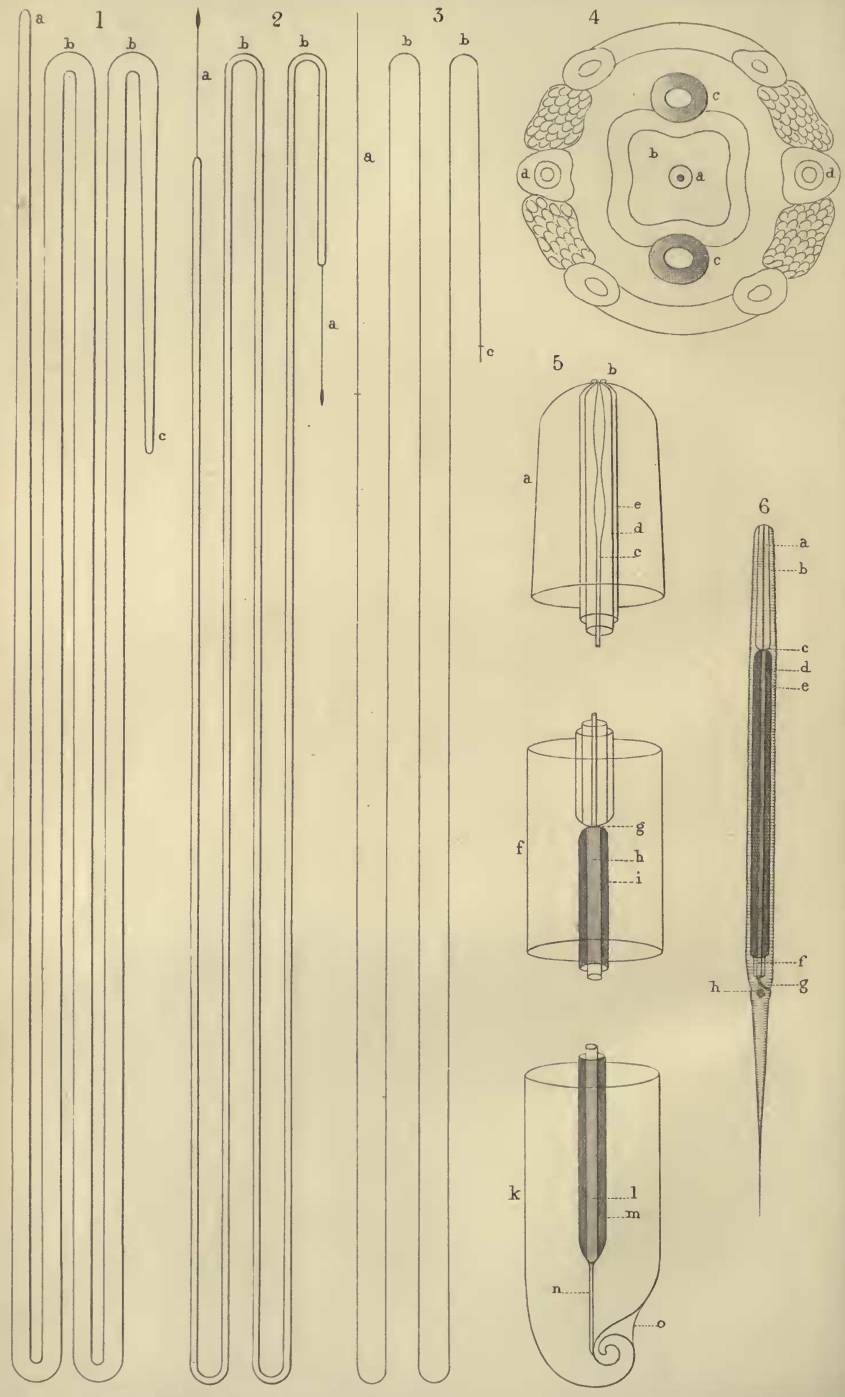
How this can be brought to bear upon the time required for the full development of *Filaria Medinensis* I am unable to state. According to my observations, *Urolabes palustris* ceases to lay by the beginning of May, and commences to breed as early as January: after May, and on to August, all the females that I have met with, although robust, have presented a shrunken state of the generative organs, and have been without ova. If, then, we assume that all the other species follow this type, and that it is a *Urolabes* which passes into the human body and becomes transformed into *Filaria Medinensis*, then the time required for the development of the latter would be very short. But then there are a number of species, perhaps, which only come into active life and breed during the "rains"—at least, I have never met with them at any other period; and if it be one of these, either in an embryonic or full-grown state, which enters the body, then the time for their development into *F. Medinensis*, as they can only enter during the "rains," must be at least ten months; while there are well-authenticated cases where sailors have gone to England from Bombay, and on returning to it after about a year, have had *Dracunculus* just before they arrived at Bombay: but these cases, unless it could be shown that the individual had had no contact with water from a tropical region from the time he left it until his return, prove nothing.

Lastly, some localities are more productive of *Dracunculus* than others, and the country or the suburbs of a town more than the town itself. Thus, in the least-populated part of the island of Bombay, where the Artillery were formerly cantoned, *Dracunculus* prevailed so much, both among the men and officers, that the place had to be abandoned, and the Artillery brought back to barracks in the town,—an occurrence which, if *Filaria Medinensis* arise from one of the *Urolabes*, seems to derive explanation from the fact to which I have before alluded, viz. that the microscopic Filaridæ abound most in water where there is an abundance of Algæ and aquatic plants, and that this is more likely to be the case about uncultivated ground, and in tanks formed chiefly out of natural depressions in the soil, than in a town where there is neither one nor the other.

As regards the origin of *F. Medinensis* from *Urolabes palustris*, there can be no doubt (as the reader may satisfy himself by the illustrations) that there is an intimate resemblance between the two; to which it may be added, that *Urolabes palustris* is by far the most generally and numerously spread of all the free microscopic Filaridæ in the island of Bombay that have come under my observation; but then the transverse striæ, which are so prominently marked in the young Guinea-worm, are altogether absent in *Urolabes palustris*, while they are present in some of the others that I have described. What the value of this difference may be, I am unable to state; and it is true that in the adult *F. Medinensis* they are so faint that they can only be seen under a tolerably high microscopic power, when they appear to be the transverse fibres of the muscular, rather than rugæ of the tegumentary coat, which they clearly are in the young Guinea-worm; so that, after all, this difference between *Urolabes palustris* and *F. Medinensis* may not be much.

Thus the origin, which is the key to the history, of *Dracunculus* is still unknown, and therefore remains a subject for future and interesting inquiry, but not more so than the still further elucidation of the Filaridæ generally, both free and parasitic; for when we consider that the former abound in species, and are spread in myriads probably all over the world where there is vegetable matter for them to feed upon, in salt as well as in fresh water, in the sea and on the land, while the latter inhabit all animals, perhaps, more or less, down to the lowest worms,—that many of the former leave their habitat and vegetable food for a temporary residence in animals, to live thus on animal food, and that therefore the whole of the parasitic forms may be originally derived from the free ones,—that they not only enter animals, but live and dwell also in plants, as the Paste-worm in the wheat, and *Anguillulina Dipsaci* in *Dipsacus Fullonum**,—that a variable plurality may be peculiarly parasitic on each animal, especially among the higher orders, there being fourteen Nematoidea, of which the Filaridæ are a family, in man alone,—that some of them enter the bodies of animals as embryos, and when sufficiently stored with nutriment, leave their hosts solely for the purpose of generation,—that others, as *Dracunculus*, appear to go into the body already impregnated, and remain there until their whole progeny are ready for delivery before they make their exit,—that the muscles, the innermost parts of the body, the eye, the heart, and the blood itself, are sometimes their abode, and that in many instances their presence is still unaccounted for,—these worms, at first apparently insignificant, from their simple thread-like form and scarcity, are seen to assume

* Gervais et Van Beneden, 'Zoologie Médicale,' vol. ii. p. 101.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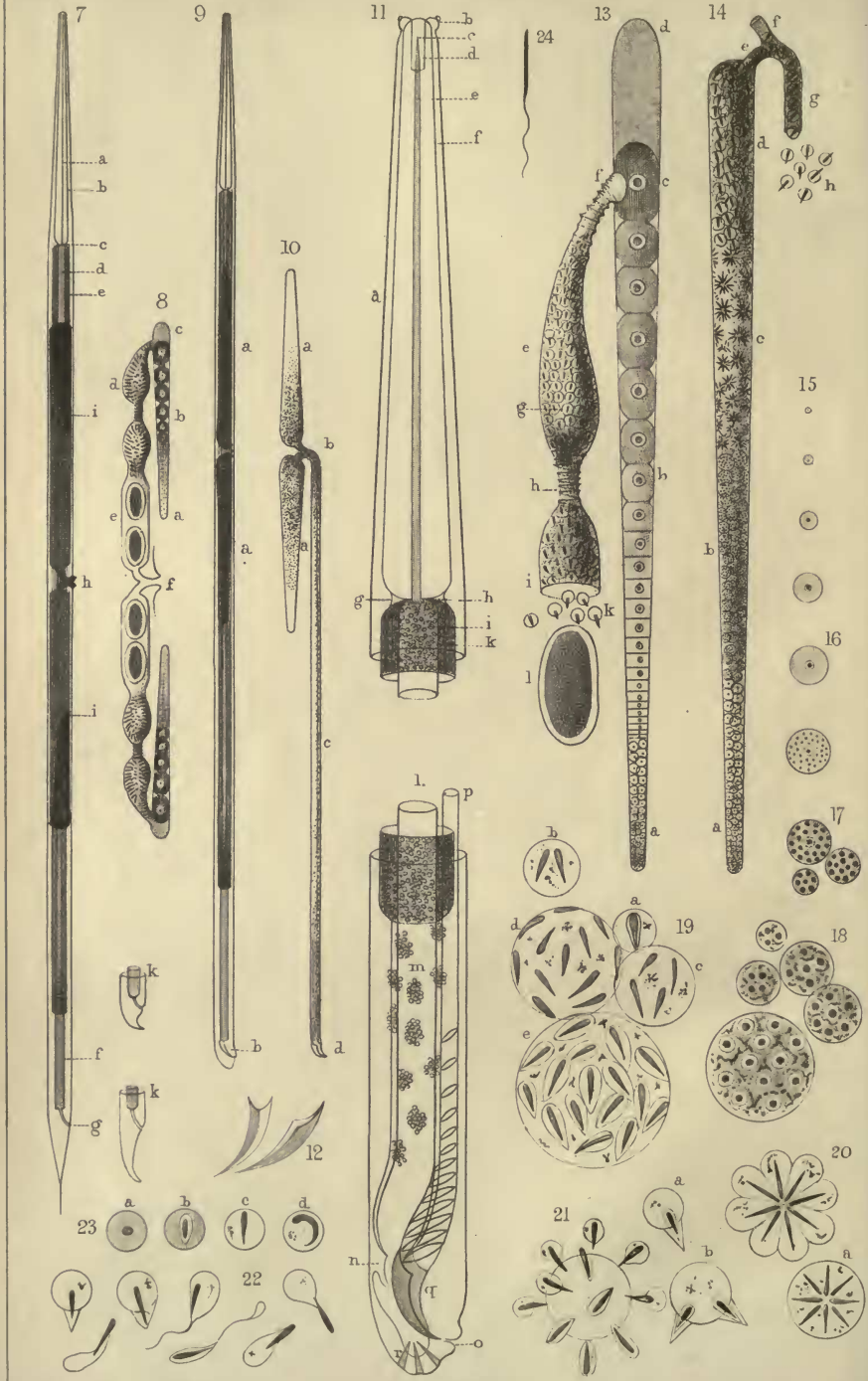
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